Description

Method for carrying out a transmission procedure in a radio communication system for a packet switched connection and radio communication system suitable for the same

Radio communication systems are used for the transmission of information, speech or data, with the aid of electromagnetic waves over a radio interface between a sending and a receiving radio station. An example of a radio communication system is the known GSM mobile radio network, as well as its further development GPRS, for which the network architecture is described for example in B. Walke, "Mobilfunknetze und ihre Protokolls" (Mobile Radio Networks and their Protocols), Volume 1, Teubner-Verlag Stuttgart, 1998, Pages 139 to 151 and Pages 295 to 311. In this case a channel formed from a narrowband frequency range and a time slot is provided in each case for transmission of a subscriber signal.

For packet switched data transmission the data is transmitted for a number of subscribers in the time division multiplex over one and the same channel. Each subscriber can thus occupy a number of channels simultaneously in this case.

For packet switching, a radio communication system, for example a GSM mobile radio network with GPRS, comprises a plurality of packet data service nodes (Serving GPRS Support Node, SGSN) which are internetworked and establish access to a fixed network. The Serving GPRS Support Nodes are further connected to Base Station Controllers (BSC). Each Base Station Controller in its turn makes possible at least one connection to at least one Base Station (BTS) and handles the administration of the technical resources of the base stations connected to it. Such a base station is a transceiver unit which can establish a telecommunication connection to mobile stations over a radio interface.

The individual subscribers are assigned to a channel via a packet data control unit which is provided in the base station controller in each case.

An area covered by a radio communication system is divided up into individual radio zones which are also referred to as cells. A cell here is served by one of the base stations via which radio connections are set up from mobile stations located in this cell. Further the area which is covered by a radio communication system is subdivided into residence zones, also known as routing areas. A routing area in this case comprises a number of radio cells. The area which is controlled by a Serving GPRS Support Node (SGSN) can be assigned a number of routing areas. The routing areas are administered by an administration system which is frequently also referred to as Mobility Management and is housed on the packet service node.

If a mobile station moves from the area of a cell into another cell, if the radio connection is still in place, an automatic procedure known as a handover is undertaken. This means that an active radio connection is retained even across cell borders. In the handover procedure the radio connection which is established over a first transceiver unit is switched over to a second transceiver unit.

If a mobile station moves out of the territory of one routing area into another routing area a process known as a routing area update must be undertaken. The mobile station is assigned an identifier in the relevant routing area, known in the GPRS system by the name of Temporary Logical Link Identifier (TLLI). In this case the mobile station must be assigned a new TLLI in the new routing area.

In the GPRS system, Release 5 (see 3GPP TS23.060, Pages 32 to 110) there is provision for the mobile station to establish the necessity for a handover procedure for packet switched data. If a handover procedure is to be performed for a mobile station the mobile station registers with the base station of the new cell. If a change of routing area is taking place at the same time, a procedure for routing area update must first be performed, in which the mobile station will be assigned a new identifier. Only after the procedure for routing area update has successfully concluded can the exchange of data between the new transceiver unit and the mobile station continue. During the routing area update procedure the exchange of data is interrupted. This interruption is perceived as disruptive for various applications such as streaming applications or conversational services for example.

The underlying problem to be resolved by the invention is thus that of specifying a method and a suitably adapted radio communication system for executing a handover procedure for a packet switched connection in which the length of time during which the exchange of data is interrupted is reduced.

This problem is resolved in accordance with the invention by a method in accordance with Claim 1 and a radio communication system in accordance with Claim 11. Further embodiments of the invention are produced by the subclaims.

A packet switched connection is set up between a mobile station and a first transceiver unit. In this case the mobile station is assigned to a first cell, which is served by a first transceiver unit, and a first routing area. If the mobile station now moves into a second cell which is served by a second transceiver unit, and into a second routing area, the connection is assigned a routing area

update identifier. Subsequently a handover procedure of the packet switched connection from the first cell into the second cell is performed. After the handover procedure an exchange of data is resumed again over the packet switched connection. After the exchange of data is resumed a procedure for routing area update is performed.

Since, in the method in accordance with the invention, the procedure for routing area update is not performed until after the exchange of data has been resumed after the handover procedure, the procedure for routing data update runs in parallel with that for data exchange. This means that the length of an interruption to the data exchange during the handover procedure is greatly reduced. Since the connection is allocated a routing area update identifier which is available in the radio communication system, it is also possible before the procedure for routing area update is performed, to send data to the mobile station which is now in the second cell and the second routing area.

Preferably, before the handover procedure from the first cell into the second cell is executed, radio resources for the packet switched connection are reserved in the second cell. This enables the switchover of the packet switched connection from the first cell to the second cell to be undertaken very quickly, so that in practice an interruption to the exchange of data will be avoided

Preferably data packets for the mobile station which arrive at the first transceiver unit are duplicated as soon as the routing area update identifier is allocated to the connection, that is as soon as it is clear that there is provision for a switchover from the first cell into the second cell and the first routing area into the second

routing area. The duplicated data packets are made available in the second transceiver unit, so that the identical data packets are present in both the first transceiver unit and also in the second transceiver unit. The data packets can be duplicated in the first transceiver unit. In this case the duplicated data packets must be transferred via an assigned Serving GPRS Support Node SGSN to the second transceiver unit. Alternatively the data packets can be duplicated in the assigned Serving GPRS Support Node SGSN, from which the data packets are transmitted to the first transceiver unit and to the second transceiver unit. The duplication of the data packets during the time for the handover procedure from the first cell into the second cell ensures that data packets arriving during this period reach the mobile station regardless of via which of the transceiver units the connection is currently switched.

It is within the scope of the invention, that, after the handover procedure, at least for a transitional period, the same data compression and the same data encryption are used as before the handover procedure. The advantage of this is that the handover procedure runs below the layers responsible for data compression and data encryption. These layers, usually LLC (Logical Link Control) and SNDCP (Sub-Network Dependant Convergence Protocol), and the associated protocols can thus continue to be used unchanged. In addition the signaling overhead for a reconfiguration of encryption and compression is avoided.

It is within the scope of the invention for the mobile station in the first routing area to be assigned a first identifier and in the second routing area a second identifier. The first identifier and the second identifier can be embodied as Temporary Logical Link Identifiers TLLI. For the switchover of the mobile station into the second cell the mobile station will be assigned a temporary

identifier which is used until the procedure for routing area update has been performed. This temporary identifier enables the mobile station to be reached in the second cell, although the procedure for routing area update has not yet been performed. The temporary identifier can be assigned to the mobile station by an administrator, for example the network operator. Alternatively the temporary identifier can be assigned by the associated Serving GPRS Support Node SGSN.

The temporary identifier can be selected from a set of reserved identifiers available for this purpose. These can typically be specific TLLI identifiers, which can for example be designated as handover TLLIs. These identifiers are for example specified by the administrator.

Alternatively the temporary identifier will be made up of a first identifier and of a supplementary identifier, for example a flag. The supplementary identifier is simply appended to the first identifier or prefixes it. The routing area update identifier can for example be used as a supplementary identifier.

Since in the radio communication network it is known from the routing area update identifier assigned that the mobile station with a foreign identifier is located in the second routing area, it is guaranteed in this way that data intended for the mobile station reach the mobile station. A foreign identifier here is taken to mean an identifier which is not assigned to the second routing area, or alternatively an identifier which is assigned to the second routing area but for which an entry has not yet been made in the Mobility Management, as would be the case for a correctly registered subscriber, since the procedure for routing area update has not yet been performed.

It is within the scope of the invention, at the end of the handover procedure, to transmit a data packet from the mobile station to the second transceiver unit. Based on the receipt of this data packet the second transceiver unit recognizes that the handover procedure can be completed and starts sending to the mobile station. The data packet which is sent from the mobile station to the second transceiver unit can, if there is no data present to be sent from the mobile station to the transceiver unit, be generated separately for this purpose.

The invention is described in more detail below on the basis of an example shown in the Figure:

The Figure shows a schematic of the exchange of messages for a cell and routing area update between a mobile station, a base station system and a Serving GPRS Support Node SGSN.

In a first cell, which is served by a first transceiver unit, a packet switched connection 1 is established from a mobile station MS via a base station system BSS to a Serving GPRS Support Node SGSN. In this case data is transmitted both in the uplink direction from the mobile station MS to the base station system BSS and also in the downlink direction, from the base station system BSS to the mobile station MS. In addition measurement reports 2, from which the quality of the connection between the mobile station MS and the base station system BSS can be derived, are sent between the mobile station MS and the base station system BSS. On the basis of the measurement reports 2 the necessity for a change from the first cell into a second cell and from a first routing area into a second routing area is recognized in the base station system BSS.

After this a preparation 3 for a handover procedure is started in the base station system BSS. Radio resources are reserved in the second cell for this purpose. This includes the reservation of the transmission capacity on the uplink and downlink channels in the second cell. Furthermore virtual data connections, so-called Network Service Virtual Connections, are reserved for the uplink direction in the second cell. Furthermore the packet switched connection is assigned a routing area update identifier, for example Routing Area Change.

Subsequently a request 4 for a handover procedure is directed to the Serving GPRS Support Node SGSN. The request 4 contains as one of its parameters the routing area update identifier Routing Area Change, identifying the second cell, into which the handover procedure is to lead, as well as information about the properties of the packet data which will be transmitted over the packet switched connection. This type of information is for example so-called Packet Flow Contexts, from which priority and quality of service of the packet data involved are obtained.

In the Serving GPRS Support Node SGSN the packet switched connection is then put into a special mode 5, which for example is called Handover with delayed Routing Area Update. Simultaneously virtual data connections, for example Network Service Virtual Connections, are reserved in the second cell for the downlink direction. It is also ensured that incoming data packets are duplicated and are forwarded to the first base station and the second base station.

Subsequently the Serving GPRS Support Node SGSN transmits to the base station system BSS an instruction 6 for a handover procedure. The routing area update identifier in the form of the specific state

handover procedure with delayed routing area update is sent as an argument. The instruction 6 also includes a temporary identifier HO-TLLI, which is assigned to the mobile station by the Serving GPRS Support Node SGSN. The instructions 6 does not contain any information for reconfiguration of higher layers. In the base station system the instruction 6 is supplemented by parameters of the reserved radio resources, which generates an instruction 7 which is transmitted from the base station system BSS to the mobile station MS.

The mobile station announces itself in a request for communication process 8 with the temporary handover identification HO-TLLI in the second cell and is registered by the base station system BSS. The handover procedure is then ended. The mobile station MS transmits to the base station system BSS a message 9 which signals the end of the handover procedure. This message is called HO-Complete for example. Furthermore the mobile station MS initiates a data transfer 11 to the base station system BSS and transmits to the mobile station MS a data packet in the uplink direction to the base station system and to the Serving GPRS Support Node SGSN. The message 9 HO-Complete can be sent and the data transfer 11 of the data packet undertaken simultaneously or consecutively. In this case it makes no difference whether the message 9 is sent first or the data 11 is transferred first. The message 9 produces an action 10 in the base station system BSS which causes data stored in the base station system BSS for the downlink direction to be sent from the base station system BSS to the mobile station MS. In addition the base station system BSS releases radio resources in the first cell.

The receipt in the Serving GPRS Support Node SGSN of the data packet which was sent in the data transfer 11 brings about an action 12 which causes the duplication of the data packets to be ended. Furthermore the radio resources are released for the first cell. A data transfer 13 in the downlink direction is then undertaken

exclusively from the Serving GPRS Support Node SGSN via the second transceiver unit to the mobile station MS.

After the exchange of data 11,13 between the mobile station MS and the base station system BSS and the Serving GPRS Support Node SGSN has been resumed again, a procedure 14 for a routing area update is executed in the known way.

In the example described it has been assumed that the first cell and the second cell are served by base stations belonging to one and the same base station system BSS. If this is not the case, the preparation 3 of the handover procedure and the ending 9 of the handover procedure are each undertaken in conjunction with the Serving GPRS Support Node SGSN.

If is also assumed that the data packets are duplicated in the downlink direction in the Serving GPRS Support Node SGSN. A possible alternative is also to duplicate the packets in the base station system BSS. The duplication ensures that data packets to be sent in the downlink direction are kept available during the handover procedure both in the first transceiver unit and also in the second transceiver unit.